



**Surface Water Assessment
(WRM, 2007)**



INTEGRA COAL OPERATIONS PTY LTD

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**GLENNIES CREEK COAL MINE
UNDERGROUND EXTENSION PROJECT
LONGWALL PANELS 10 TO 17
SURFACE WATER ASSESSMENT**

Prepared for:

Integra Coal Operations Pty Ltd
C/o GeoTerra Pty Ltd
77 Abergeldie Street
Dulwich Hill
NSW 2203

Report Number	Report Date	Author	Reviewer
00732-C [Rev 3]	10 April 2007		
		Sharmil Markar	Greg Roads

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1 INTRODUCTION

Glennies Creek Coal Management Pty Ltd (acting as manager on behalf of Integra Coal Operations Pty Ltd) proposes to extend the underground mining at the Glennies Creek Coal Mine to extract coal from the Middle Liddell Seam by mining panels 10 to 17. The mine site is located approximately 12km north of Singleton in the Hunter Valley of NSW.

The Glennies Creek and Camberwell mining operations have recently been merged and are now run as a combined operation by Integra Coal Operations Pty Ltd. The proposed extension of underground mining activities at the Glennies Creek Coal Mine will thus become a part of this combined Integra Coal operation. Full details of the background, current and future mining operations at Glennies Creek Coal Mine and the proposed underground extension are contained in the Environmental Assessment (EA) document (ERM, 2007).

It is understood that the project area for this application is defined as the subsidence area surrounding Longwall Panels 10 to 17 extending laterally as far as the 20mm limit of subsidence.

As part of the EA for the proposed underground mine extension, WRM Water & Environment Pty Ltd (WRM) was requested to undertake a desktop surface water assessment of the catchments affected by the extended underground mining operations. This report has been prepared in response to this request. The report draws upon data and information from a number of sources, including observations made by a WRM representative during an inspection of the affected catchments.

2 CATCHMENT CHARACTERISTICS

2.1 REGIONAL DRAINAGE CHARACTERISTICS

The proposed underground mine extension works (Longwall Panels 10 to 17) are located mainly in the catchment of Bettys Creek, which is a tributary of Bowmans Creek (also known as Foy Brook). Bowmans Creek is a tributary of the Hunter River. Bowmans Creek has a mainstream channel length of approximately 50km and a total catchment area of approximately 266km². Figure 2.1 shows the regional drainage network in the study area.

2.2 BETTYS CREEK DRAINAGE CHARACTERISTICS

Bettys Creek drains in a south-westerly direction into Bowmans Creek approximately 6.0km upstream of the Bowmans Creek confluence with the Hunter River. The catchment has slopes varying from 3 to 4 percent in the southern part to 20 percent on the upper slopes of the northern part (Earth Tec, 2006). It is a third order watercourse under the Stahler ordering system and a Schedule 1 or 2 stream under the DIPNR (2005) guidelines (WRM, 2006a).

Bettys Creek system is ephemeral and flows only occur during storm events or after prolonged periods of heavy rain (Umwelt, 2003). Generally the creek system is predominantly dry. However, there are some pools of permanent or semi-permanent water present along the downstream reaches of the creek. Water in these pools has been found to be saline (Umwelt, 2003).

The general topography of the catchment consists of undulating, elevated hills with pasture and isolated woodland areas. There is little or no riparian vegetation along the upper reaches of the creek. However, along the lower reaches there is some well established riparian vegetation dominated by She Oaks. There is also evidence of extensive erosion of the creek banks in the upper reaches of the creek where there is no riparian vegetation (Umwelt, 2003).

It appears that the catchment has been extensively modified through clearing for mining, logging and grazing activities (GeoTerra, 2006).

Figure 2.2 shows Bettys Creek where it crosses the proposed underground mine extension works. The creek drains along Longwall Panels 15 (LW15) and 14 (LW14) before travelling directly across Longwall Panels 13 to 10 (LW13 to LW10). According to WRM (2006a), along LW15, the creek is typically a Schedule 1 stream (DIPNR, 2005) that is characterised by a V shaped channel some 50 m wide with little to no floodplain and bed slopes of the order of 0.6% to 1%. Across LW14 to LW10, the creek is more typical of a Schedule 2 stream (DIPNR, 2005). The bed slope decreases to about 0.3% to 0.6%, and the main channel becomes more sinuous and the floodplain width increases. The bank full flow capacity of the creek downstream of Longwall Panel 15 is about the 1 year average recurrence interval (ARI) design flow (WRM, 2006a).

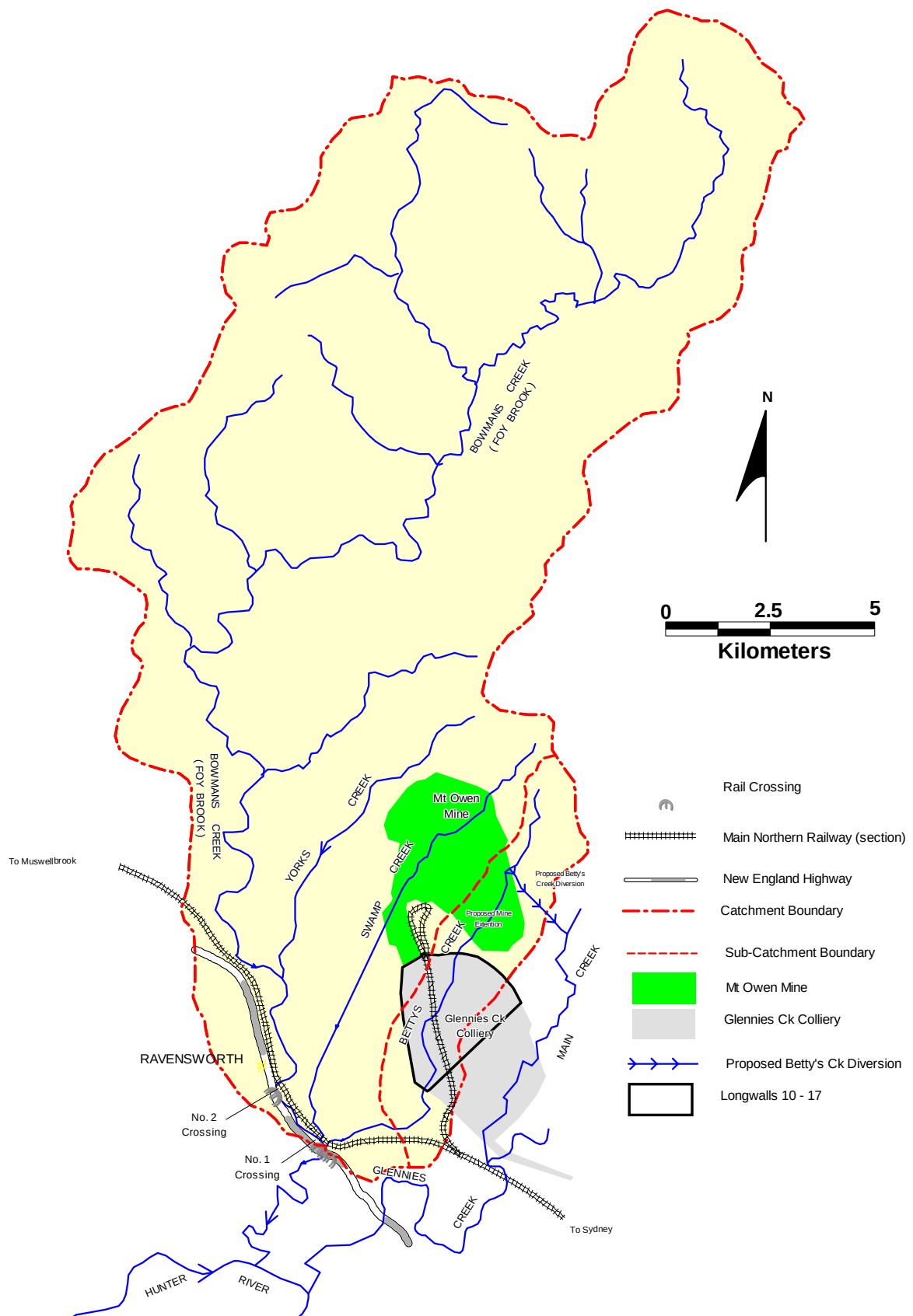


Figure 2.1 Glennies Creek Colliery and Regional Drainage Characteristics

A number of first order streams also cross the area impacted by the proposed underground mine works (see Figure 2.2). These streams have catchment areas up to 0.5km² and main stream lengths of 0.5 to 1 km. Bed slopes are of the order of 1.5% to 2.5%. Erosion is evident along much of the first order streams.

The 100 year ARI design flood in Bowmans Creek does not impact on Bettys Creek flood levels across the area covered by Longwall Panels 10 to 17 (WRM, 2006a).

2.3 CATCHMENT AREAS

Bettys Creek has a mainstream channel length of approximately 12km and a total catchment area of approximately 16.4km². Of this, 10.9 km² lies within the Mt. Owen project area. Main Creek has total catchment area of 17.5km². The Longwall Panels 10 to 17 are located within the Bettys Creek catchment, except for an area of approximately 0.84km² located within the Main Creek catchment.

2.4 RAINFALL AND EVAPORATION

Based on 21 years (1969-1990) of historical rainfall data collected at the Bureau of Meteorology station at Singleton (Station 61275), the average, median, 10% and 90% annual rainfalls in the study area are 723mm, 735mm, 526mm and 920mm respectively.

Based on 37 years (1967-2004) of historical pan evaporation data collected at the Bureau of Meteorology at Patterson (Station 061250), the average annual pan evaporation in the study area is about 1570mm.

2.5 WATER FEATURES

There are a significant number of storages in the area of interest. Details of these storages are given in GeoTerra (2006). Summary details of these storages are as follows:

- There are 19 dams and billabongs, all on land owned by Xstrata, in the area overlying Longwall Panels 10 to 17.
- There are a further 7 dams located over Longwall Panel 9 (external to Longwall Panels 10 to 17) but within the Longwall Panels 10 to 17 subsidence zone.
- There are no earth wall dams located over Longwall Panels 12, 16 and 17.
- There are several billabongs (with and without earth fill bunds) along the Betty Creek channel that temporarily store runoff for up to few weeks after a rain event.
- All dams are small to moderate size, with estimated storage capacities varying between 0.2ML and 30.3ML.
- All dams except one have walls up to about 2m high, the only exception having a wall up to about 5m high.

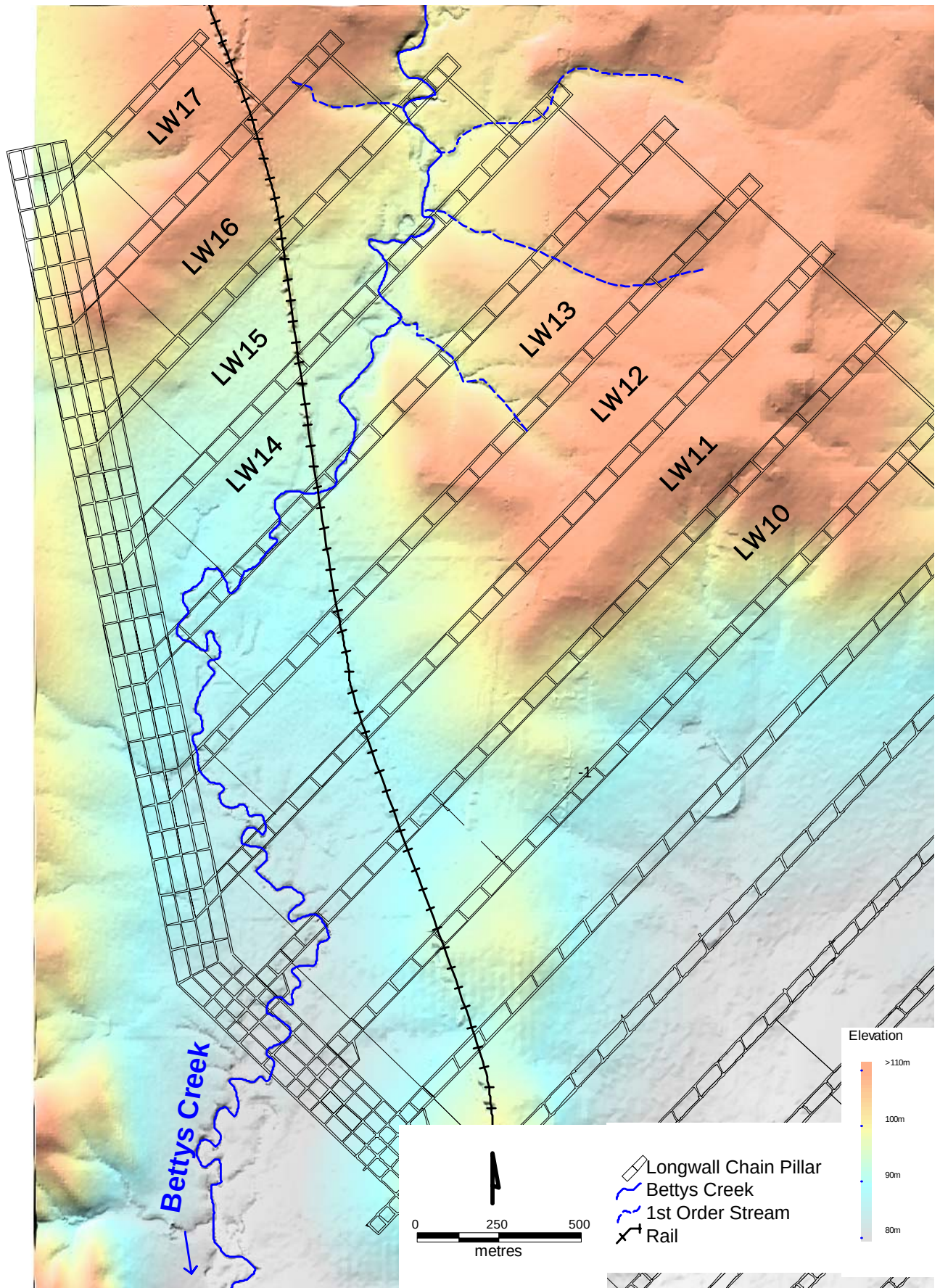


Figure 2.2 Bettys Creek and Glennies Creek Coal Mine Longwall Panels 10 to 17

2.6 WATER QUALITY

Surface water quality data available for the project area is limited. In the project area, some water quality data from ponded water in isolated small pools along Bettys Creek have been obtained during a dry period. This data is unlikely to be representative of the water quality in the creek when it is flowing. Data collected indicate that Bettys Creek water in the ponded areas is saline due to groundwater seepage (GeoTerra, 2006). Data from these isolated small pools indicate that the ponded water quality is generally within ANZECC (2000) trigger levels, except for EC, NO₃, Cu and Zn. Further details on Bettys Creek water quality are given in GeoTerra (2006).

Mt. Owen Mine has monitored water quality in Bettys Creek at a location upstream of the project area since 1992 (Umwelt, 2003). This data indicate that the Bettys Creek upstream water quality is neutral to alkaline, with pH ranging from 6.2 to 9.4. EC values have ranged from 81 μ S/cm to 18,000 μ S/cm. The flow rates associated with these EC values are not known.

Field measurements of water quality in 13 dams in the project area indicate that water stored in these dams have near neutral pH (6.05 to 7.82) and ECs ranging between 112 μ S/cm and 913 μ S/cm (GeoTerra, 2006). Laboratory testing of samples collected from 4 selected dams over Longwall Panels 10 to 17 indicate that electrical conductivity, total nitrogen, total phosphorous and to a lesser degree pH and copper levels are above ANZECC (2000) trigger levels. Further details of these results are given in GeoTerra (2006).

2.7 WATER USERS

There are no known surface water users along Bettys Creek within the area affected by Longwall Panels 10 to 17 or further downstream up to Bowmans Creek.

3

MT. OWEN MINE IMPACTS ON LOCAL DRAINAGE

3.1 GENERAL

Mt. Owen Open Cut Coal Mine is located near Hebden to the north of Glennies Creek Coal Mine, about 25km north-west of Singleton. As part of the approved expansion of mining activities at the Mt. Owen mine, Xstrata is planning to undertake a number of permanent and temporary diversions of Bettys Creek (Umwelt, 2003). These include:

- a permanent diversion of the upper section of the creek (25% of the catchment) to Main Creek, the adjoining creek to the east; and
- temporary and permanent diversions around proposed operational works and within the creek reach affected by the proposed Longwall Panels 10 to 17.

The details and the designs of the proposed diversions are presented in Earth Tech (2006). Figure 3.1 shows the locations of the proposed Xstrata diversion works. The main diversion works proposed are as follows:

- The West Dump diversion (Diversion 1);
- The Eastern Rail Pit diversion (Diversion 2); and
- The upper catchment diversion to Main Creek (Diversion 3);

In addition to the above major diversion works, some minor diversions of first order streams are also proposed.

It is understood that all of the above diversion works have been approved by the relevant government agencies. A brief description of the major diversion works is given below.

3.2 WEST DUMP DIVERSION (DIVERSION 1)

The West Dump Diversion (WDD) conveys flows from north to south in a meandering alignment. The proposed channel runs along the eastern side of the west dump of the Mt. Owen mine. The WDD channel has a slope of 0.25% and is 1090m long. It has been designed to convey all flows up to and including 100 year ARI design flood, with an additional freeboard of 0.5m. The channel will be constructed with in-stream ponds and revegetated with suitable vegetation.

A temporary east-west diversion of the WDD will be constructed to Bettys Creek during the operations at the Eastern Rail Pit. It is proposed that this temporary diversion of the WDD will be plugged/ decommissioned at the appropriate development phase.

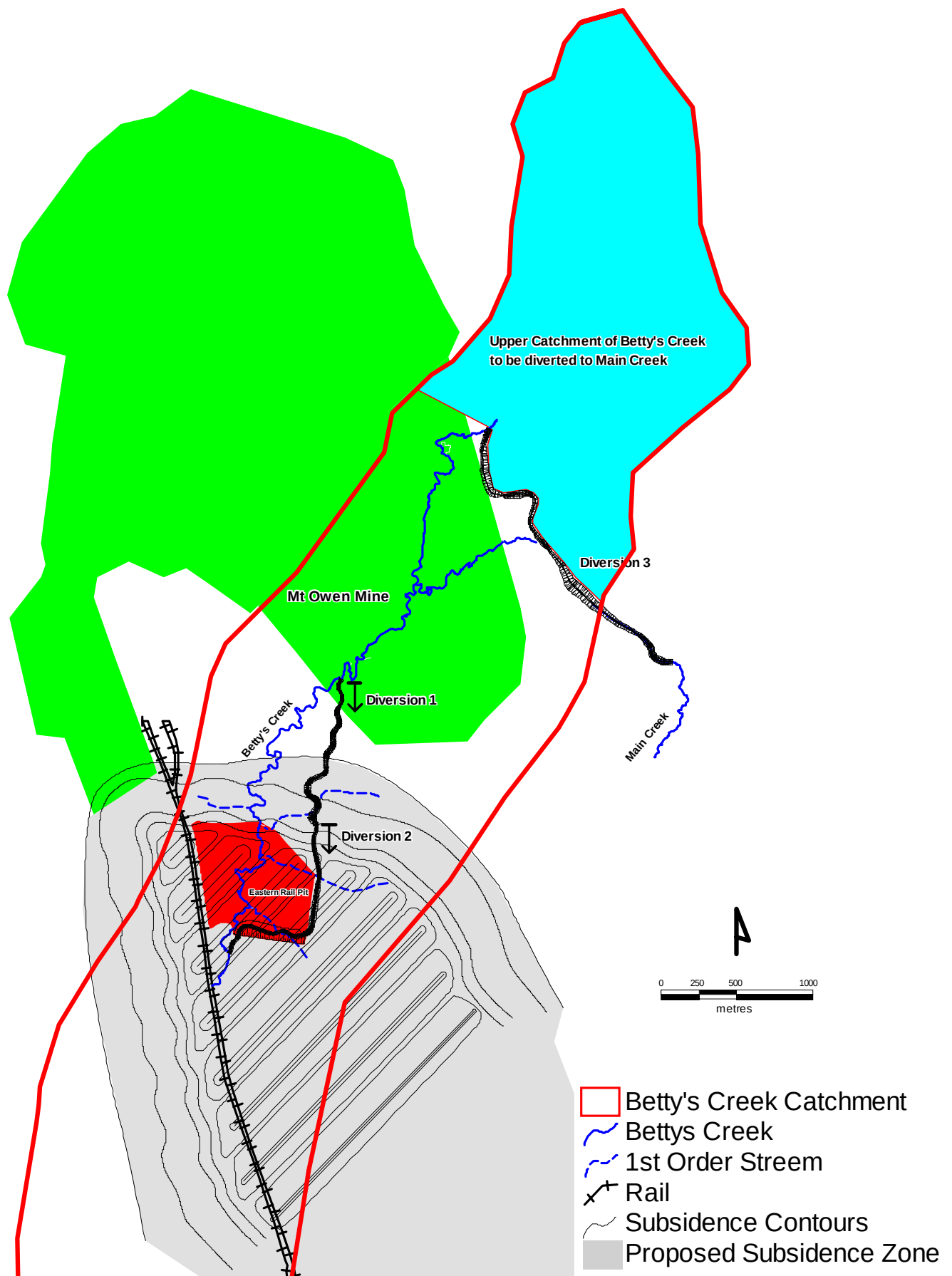


Figure 3.1 Locations of the Bettys Creek Diversions Proposed by Xstrata (Mt.Owen)

3.3 EASTERN RAIL PIT DIVERSION (DIVERSION 2)

The Eastern Rail Pit Diversion (ERPD) will convey flows from WDD in a southerly direction for a length of 855m, and then turn into a westerly direction for 550m to rejoin with Bettys Creek. The north-south section of the ERPD will be straight at a grade of 0.58%. It has been designed to convey all flows up to and including 100 year ARI design flood, with an additional freeboard of 0.5m. It is proposed that the channel will be planted with flora typical of Bettys Creek and in-stream ponds will be constructed.

Three drop structures will be constructed along the east-west section of the ERPD. The drop structures will have a grade of up to 4% and will be rock armoured for scour protection. The remainder of the section will be vegetated with a meandering alignment at a grade of 0.94%.

3.4 UPPER CATCHMENT DIVERSION TO MAIN CREEK (DIVERSION 3)

The upper catchment diversion will divert some 412ha (25%) of the Bettys Creek catchment to Main Creek, reducing the downstream catchment area from about 16km² to 11km². This will significantly reduce the design flows draining along lower reaches of Bettys Creek and into the proposed southern diversions. This diversion is located approximately 2.5km upstream of Longwall Panel 16. It will not be impacted by the Integra Coal operations because it is not within the subsidence impact zone.

4 SURFACE WATER IMPACTS

4.1 GENERAL

Any potential surface water impacts of the proposed Longwall Panels 10 to 17 mining will be due to the differential settlement caused by mine subsidence on drainage characteristics in overlying creek systems. In this case, any impacts will be limited to Bettys Creek and its local drainage network. Although the subsidence zone extends a little into the Main Creek catchment no impact is expected on the Main Creek itself or its drainage network because the area of impact is not significant. Hence, this report focuses only on the Bettys Creek catchment impacts.

A discussion of the impacts of mine subsidence on Bettys Creek under existing creek conditions as well as the proposed Mt. Owen creek diversion conditions is given below. Some comments on the impact of Mt. Owen diversions on Bettys Creek without the mine subsidence are also given.

4.2 IMPACTS UNDER EXISTING CONDITIONS

4.2.1 Topographical Impacts

Figure 4.1 shows the predicted mine subsidence impact zone and the subsidence contours along Bettys Creek and its floodplain as predicted by SCT (2006). They show that the ground levels could be reduced depths of up to 1.6m along the centre of each Longwall Panel and up to 1.5m above the chain pillars. The mine subsidence impacts on Bettys Creek and its first order streams are summarised as follows (WRM, 2006a):

- The bed slope of the creek along Longwall Panel 15 is likely to increase from about 0.4% under existing conditions to about 0.6% over a distance of 600m as it drains into the mine subsidence area.
- The bed slope of the creek along Longwall Panel 14 to the Mt. Owen railway line is unlikely to change significantly because mine subsidence is relatively consistent at 1.0m to 1.5m across both the main channel and floodplain.
- Downstream of the Mt. Owen railway, the bed slope of the creek main channel will reduce from 0.3% under existing conditions to 0.05% for a distance of about 350m as the creek channel drains out of the subsidence area.
- Differential settlements of about 1.0m to 1.5m will occur between the left overbank and the adjacent main channel downstream of the railway, which could potentially change the nature of floodplain flows.
- There will generally be little differential settlement along most of the first order streams.

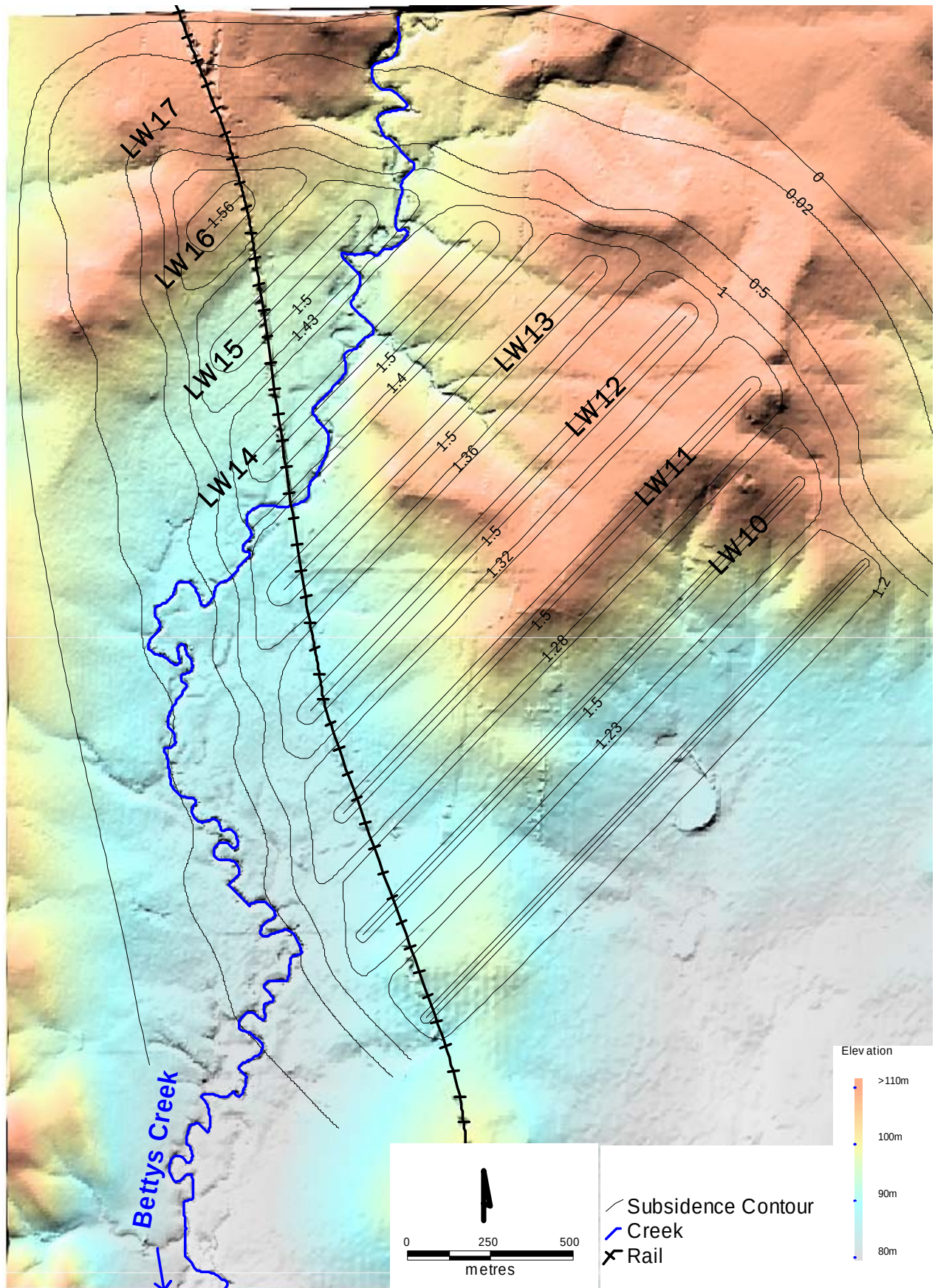


Figure 4.1 Bettys Creek and Predicted Subsidence Contours

A detailed assessment of the impact of mine subsidence on the rates of erosion and flooding behaviour of Bettys Creek is presented in WRM (2006a). The findings are described in sections 4.2.2 and 4.2.3.

4.2.2 Erosion Impacts

The erosion impacts of mine subsidence were assessed by determining the Bettys Creek channel maximum flow velocities, shear stresses and stream powers under bank full (1 year ARI design flood) flow conditions for existing and post-subsidence scenarios. It was found that:

- The 1 year ARI design flood velocities along Bettys Creek for existing conditions vary from 0.67m/s to 1.19m/s. The equivalent velocities for post-subsidence conditions vary from 0.60m/s to 1.27m/s.
- The 1 year ARI design shear stresses for existing conditions vary from 20.2N/m² to 63.6N/m². The equivalent shear stresses for post-subsidence conditions vary from 16.9N/m² to 72N/m².
- The 1 year ARI design stream powers for existing conditions vary from 13.6N/m.s to 75.8N/m.s. The equivalent stream powers for post-subsidence conditions vary from 10.2N/m.s to 91.5N/m.s.

As expected, subsidence will increase channel velocities, shear stresses and stream powers between Cross-section 9 and Cross-section 11 (see Figure 4.2 for locations) as the creek drains into the subsidence area. This may increase channel erosion in this area. Decreased channel velocities, shear stresses and stream powers will occur between the Mt. Owen railway line and Cross-section 5 and also between Cross-section 1 and Cross-section 2 where the main channel drains out of the mine subsidence area. Increased sediment deposition may occur in these areas.

It is noted that the velocities, shear stresses and stream powers are not very significant for the 1 Year ARI event for either the existing or post subsidence conditions. It is also noted that the range of velocities, shear stresses and stream powers for both existing and post-subsidence conditions are generally similar, and this indicates that any increased erosion and sedimentation will not be significant.

4.2.3 Flooding Impacts

Figure 4.2 shows the 100 year ARI flood extent over the area of interest for existing conditions and the predicted post-subsidence conditions. The following is of note with respect to flooding impacts.

- The Mt. Owen Railway Bridge does not get overtopped for existing or post-subsidence conditions.
- Under existing and post-subsidence conditions, the Mt Owen rail bridge will divert some of the 100 Year ARI flow along the upstream side of the rail in a southerly direction (see Figure 4.2). It is unknown where this secondary flow path rejoins Bettys Creek.
- The existing and post-subsidence flood extents do not change upstream of the Mt. Owen railway line between Cross-section 12 and Cross-section 7.
- Downstream of the Mt. Owen railway line, the differential settlement between the left and right overbank floodplains causes a reduction in the left overbank flows and an increase in the right overbank flows and resultant flood extents. However, the overbank flows for both existing and post-subsidence conditions for the 100 year ARI flood are generally less than 0.5m deep.

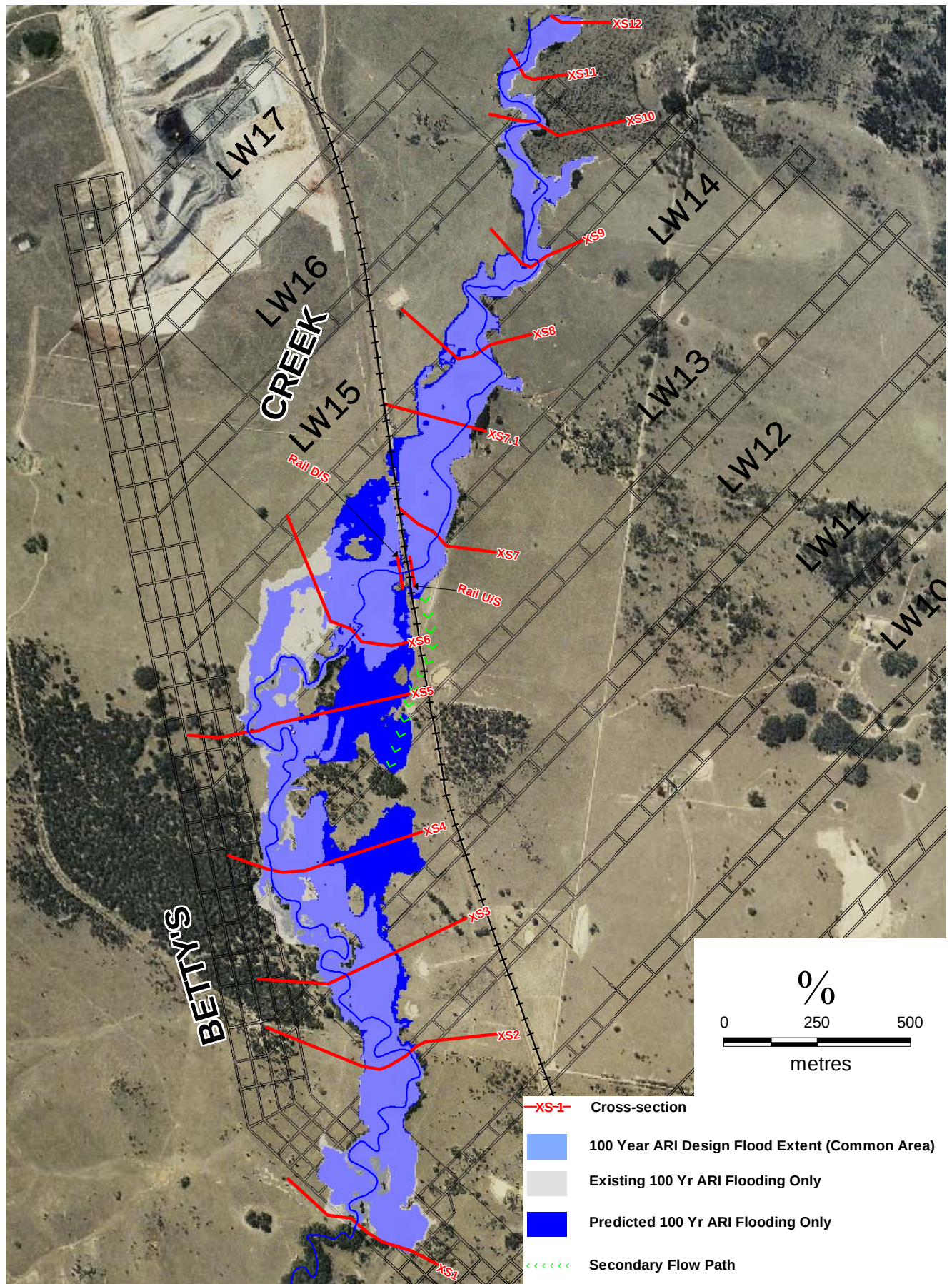


Figure 4.2 Existing and Predicted 100 Year ARI Flood Extents

- Downstream of Cross-section 2, there is little difference in flood extent between the existing and post-subsidence conditions.

In summary, the mine subsidence is likely to alter the overbank flows particularly downstream of the railway line. However, the predicted change is unlikely to cause a major channel avulsion in the short or long term because 100 year ARI flow depths are generally less than 0.5m and overbank flood velocities are generally less than 0.5m/s.

4.3 IMPACTS OF MT OWEN UPSTREAM CREEK DIVERSION

The approved Mt. Owen open cut pit (Pit 'C') extension and the diversion of the upper catchment of Bettys Creek into Main Creek will substantially reduce Bettys Creek flows across the Glennies Creek mine subsidence area. An assessment of the combined impact of mine subsidence and Bettys Creek upstream diversion to Main Creek on Bettys Creek drainage characteristics (WRM, 2006a) shows that:

- reduced flows will significantly reduce the shear stresses and stream powers along Bettys Creek during flood events. This in turn will reduce the potential for erosion to occur; and
- it is likely that Bettys Creek will silt up (aggrade) over time as there may be insufficient flows to flush out any high sediment loads draining in from first order streams.

4.4 IMPACT OF LONGWALL MINING ON MT OWEN CREEK DIVERSIONS

The temporary and permanent diversions of Bettys Creek around Mt. Owen operational works will occur in the area affected by subsidence from mining Longwall Panels 10 to 17. An assessment of the impact of the predicted subsidence on the rates of erosion and flooding behaviour of these diversions is presented in WRM (2006b).

4.4.1 Comments on the Proposed Mt Owen Diversions 1 and 2

WRM (2006b) provides the following comments with respect to the Bettys Creek Diversions 1 and 2 proposed by the Mt Owen Mine. The assessment assumed that the diversion of the upper sections of Bettys Creek (i.e. Diversion 3) had already taken place:

- The proposed diversions have not replicated all of the proposed template reach shape features. (Note: a template reach is a section of the creek that is in good condition and can be used as a reference for remediation of other reaches that are of similar geomorphic character, aspect and geology.) The natural channel consists of a channel and floodplain whereas the proposed channel is trapezoidal. The concentration of flows into a single channel could impact on the long term stability of the channel.
- The template reach, which has been used to determine the bed slopes and channel meander geometry, is based on the non-diverted flow regime. Lower flows may require a different geometry than the adopted template reach.
- The bend between the north-south and east-west sections of Diversion 2 has been designed to have a consistent geometry within the template reach and the upstream diversion reaches. However, the bend has a much longer reach length than the other sections and as such could potentially be subjected to higher shear stresses and stream powers. It is unlikely to achieve the hydraulic design performance criteria for the pre and post subsidence conditions and as such could be subject to higher rates of erosion.

- The construction of a diversion channel over unconsolidated fill along the east-west section of Diversion 2 could potentially be a significant long term problem unless constructed properly. Any differential settlement of the fill or cracking of the liner could cause the proposed drop structures to fail, which could trigger extensive erosion along this reach.
- The proposed diversion design is generally consistent with current best practice. However, there are some concerns with the construction of the channel over unconsolidated fill and the long term stability of the trapezoidal channel shape.

4.4.2 Post Subsidence Conditions

Figure 3.1 shows the Bettys Creek diversions in relation to the predicted mine subsidence contours, as predicted by SCT (2006). A description of the impacts of mine subsidence on Bettys Creek Diversions and the first order streams is given below.

- The bed slope of Diversion 1 is likely to increase slightly from chainage 463m to Diversion 2 as it drains into the mine subsidence area. At the end of the permanent section of Diversion 1, the ground level is predicted to subside by some 0.35m.
- The bed slope of Diversion 2 is likely to increase from 0.58% to 0.78% between chainage 1115m and 1404m as it drains into the subsidence area.
- The bed slope of the Diversion from chainage 1115m to the confluence with Bettys Creek will not change significantly because the mine subsidence is relatively constant at 1.5m.
- Along most of the first order streams, there will generally be little or no change in bed slope.

4.4.3 Subsidence Impacts on Diversion Channels 1 and 2

WRM (2006b) makes the following comments regarding the impact of mine subsidence on Diversion 1 and 2 Channels.

- The post-subsidence Diversion 1 channel meets the hydraulic performance criteria recommended by Earth Tech (2006). The increased maximum velocities, shear stresses and stream powers are below the maximum velocities, shear stresses and stream powers along other sections. As such, the proposed mine subsidence is not expected to significantly impact on Diversion 1.
- The post-subsidence Diversion 2 channel upstream of the backfill (the North-South section) does not meet the hydraulic performance criteria for shear stress and stream power along the upper 800m length. The diversion channel drains into the mine subsidence zone along this reach. It is recommended that this section be monitored for increased channel erosion.
- The post-subsidence Diversion 2 channel across the backfill (the east-west section) generally meets the hydraulic performance criteria recommended by Earth Tech (2006). There is also no change between pre- and post-subsidence hydraulic conditions along this reach of the channel. This means that any erosion along this reach is unlikely to be due to mine subsidence.
- Some spikes in velocity, shear stress and stream power along Diversion 2 Channel across the backfill reach occur as a result of the proposed drop structures. The drop structures will be armoured to protect against erosion. The proposed mine subsidence should not impact on the integrity of the drop structures because there is little to no differential settlement in these areas resulting from mine subsidence.

- The post-subsidence conditions have no impact on the shear stresses and stream powers at the bend between the east-west and north-south sections of Diversion 2 as well as at the bend on the downstream end of Diversion 1. As such, any erosion at this location will not be due to mine subsidence.

4.5 DAMS AND BILLABONGS

The susceptibility of the dams and billabongs within the subsidence zone has been assessed in a previous SMP application in 2005 (GeoTerra, 2006). GeoTerra (2006) also found that the subsidence under or near the dams is unlikely to significantly affect the stability of dams in the Longwall Panels 10 to 17 area.

4.6 OTHER POTENTIAL IMPACTS

It is not anticipated that the subsidence resulting from the Longwall Panels 10 to 17 mining will have any adverse impacts on surface vegetation, existing land uses, environmental flows and surface water quality.

The mine extension works associated with the proposed extension of Glennies Creek underground mine will not extract water from or discharge any waters to Bettys Creek. Further, the proposed underground mining is not expected to alter the water quality regime in Bettys Creek. Hence, the proposed extension of underground mining would have no impact on (and not be affected by) the Hunter River Salinity Trading Scheme (HRSTS).

5 SURFACE WATER CONTROLS

5.1 COMBINED GLENNIES AND CAMBERWELL OPERATIONS

An integrated surface water management plan for the combined Glennies and Camberwell mining operations is presented in PSM (2006). This plan describes the total containment 'dirty' water management system adopted for the existing and planned future mining operations, and includes the following operations.

- Camberwell Open Cut Coal Mine.
- Coal Handling and Processing Plant Water Circuit.
- Glennies Creek Underground Coal Mine (including the mining of Longwall Panels 10 to 17).
- Proposed Glennies Creek Open Cut Coal Mine.

The above water management system includes contingency measures to ensure containment of 'dirty' water within the mine site and flood protection for the underground mine access portal located in the Camberwell North Pit. It is noted that the proposed Glennies Creek Open Cut Coal Mine is yet to be approved; an EA for this project is currently under consideration by the NSW Government.

5.2 BETTYS CREEK DIVERSIONS

The surface water controls associated with the Bettys Creek diversions are not the responsibility of Integra Coal (Glennies Creek Coal Management) and therefore they are not addressed in this report. The details of surface water controls associated with the works undertaken by the Mt. Owen mine are given elsewhere (e.g. Umwelt, 2003; Earth Tech, 2006). The impacts of the proposed underground mining on these diversion works are discussed in Section 4.

5.3 LONGWALL PANELS 10 TO 17 SUBSIDENCE ZONE

The hydraulic analyses undertaken in WRM (2006a) indicate that mine subsidence will have some impact on the drainage characteristics of both the main channel and floodplain of Bettys Creek under existing creek conditions as well as proposed Mt Owen creek diversion conditions. With respect to floodplain flows, the impact is expected to be moderate and unlikely to cause a major channel avulsion in the short or long term. Similarly, the impact on the main channel is expected to be moderate and is unlikely to substantially change existing rates of channel erosion or degradation.

Given that much of the Bettys Creek catchment upstream of the proposed underground mine extension area will be diverted as part of the Mt Owen Open Cut (Pit 'C') extension, no specific mitigation measures are considered necessary for either the Bettys Creek main channel or the floodplain. However, a monitoring program (see Section 7) has been developed to assess whether rapid changes in Bettys Creek main channel or floodplain occur following runoff events. If rapid changes do occur, remediation measures (such as erosion protection works) will be designed and implemented.

Given that the proposed underground mining activities will have very little surface impact (except for subsidence), it is unlikely that Bettys Creek stream water quality will be affected by mining Longwall Panels 10 to 17. Hence, surface water controls to manage water stream water quality are not considered necessary.

5.4 CONTINGENCY MEASURES

The Glennies Creek and Camberwell mining operations already have contingency plans in place to deal with matters relating to the operation and maintenance of the surface water management system (PSM, 2006). The contingency plans are designed to ensure that 'dirty' water is not discharged into downstream receiving waters. These contingency plans will be maintained for the combined operation. It is noted that the combined Glennies Creek and Camberwell operation is a net water exporter. Hence, it has sufficient flexibility in meeting the water requirements for the proposed underground mine extension activities. This also provides the mine with the flexibility to implement a range of contingency measures if needed, including varying the rate of water exported to external users from the combined operation.

The proposed monitoring program is designed to identify any adverse impacts of mine subsidence early. This will enable the undertaking of any contingency and remedial measures as appropriate and as soon as practicable.

6 WATER BALANCE

6.1 GENERAL

Water management for the proposed underground mine extension will be integrated with the current overall water management system for the combined operations of Glennies Creek and Camberwell mines. Hence, the long-term water balance for the underground mine extension has to be considered as part of the overall water balance for the combined and integrated Glennies Creek and Camberwell mines. Details of the overall long-term water balance for the combined mining operations (including the proposed underground mine extension) are given in PSM (2006). A summary description is given below.

6.2 WATER SUPPLY

The water supply sources (inflows) to the combined operations are:

- Tailings dam seepage;
- On-site direct rainfall and surface runoff;
- Rainfall deep percolation into the Camberwell North Pit sump;
- Regional ground water inflows;
- Underground mine dewatering;
- Dewatering from the new Glennies Open Cut Pit; and
- Camberwell Open Cut Pit storage.

The following is of note concerning the water inflow calculations:

- Tailings dam seepage has been considered and quantified in the context of CHPP make up water estimation, therefore is not double counted as separate water source;
- On-site direct rainfall and surface runoff inflow has been included in the inflow calculations for the North Pit sump, Camberwell Open Cut storage and the proposed new Glennies Open Cut pit as appropriate;
- Rainfall deep percolation into the Camberwell North Pit sump is a highly transient quantity and is both significant and difficult to quantify. Based on two different methods of analysis, it has been estimated that around 1676m³/day (on average) would flow into the sump. A value of 1700 m³/day has been adopted for the water balance calculations;
- Regional groundwater inflows to the pits are considered to be small. It has been estimated that the net inflow to the proposed Glennies Creek Open Cut would vary from about 116.5m³/day in the early stages to about 44m³/day towards the end of pit life. An

average total inflow value of 100m³/day has been conservatively assumed for the water balance calculations;

- The total 'new water' contribution (by seepage and pumping direct rainfall and runoff) from the proposed Glennies Creek to the portal sump has been estimated to average about 571m³/day. A value of 600m³/day has been adopted for the water balance calculations;
- Direct rainfall and runoff into Campbell Open Cut storage has been estimated to yield, on average, about 3250m³/day.

6.3 WATER DEMAND

The water demands (outflows) for the combined operations are:

- Coal Handling and Processing Plant (CHPP) water use;
- Possum Skin and Dirty Water dam evaporation;
- Underground mine dust suppression;
- Surface dust suppression;
- Export to Rix's Creek Colliery; and
- Export to Ashton Mine.

The following is of note concerning the water demand calculations:

- Detailed calculations undertaken for the CHPP water circuit indicate that about 3000m³/day make up water would be required to meet the CHPP water demand. Make up water is required to compensate for the following losses:
 - Water exported in coal - ~860m³/day
 - Tailings dam interstitial storage - ~1250m³/day
 - Net evaporation loss from the tailings dam - ~860m³/day
- Possum Skin Dam evaporation loss has been estimated to average 493 m³/day. A value of 500 m³/day has been adopted for water balance calculations;
- Evaporation from dirty water dams has been estimated to average about 250 m³/day;
- The current haul road (2.3km²) plus coal ROM stockpile area (0.5km²) dust suppression water demand has been estimated at 1200m³/day. The operation of the proposed Glennies Creek Open Cut would increase this demand by a further 200 m³/day;
- Water is exported to Rix's Creek Colliery and Ashton Mine on as required and as available basis.

6.4 UNDERGROUND MINE SUPPLY AND DEMAND

Data available on underground mine dewatering is limited. It is reported that groundwater inflows around 2,000m³/d were observed during initial development of the existing underground mine. However, over time this rate continued to decline to an average dewatering rate of about

800m³/d to 1,200m³/d (average about 1,000m³/d). This rate more or less matches the current operational water supply requirement (1,000m³/d) for the underground mine (PSM, 2006).

While the possibility of underground mine expansion intersecting stronger seepage sources remains, the more extensive the underground mining becomes the less likely that a significant new source will be encountered due to the dewatering of surrounding material that has already occurred (GeoTerra, 2007).

For the water balance calculations, it has been conservatively assumed that the Glennies Creek underground mining activities will produce 200m³/d of 'new' seepage water into the water management system.

6.5 ANNUAL WATER BALANCE

Based on detailed analyses presented in PSM (2006), Table 6.1 and Table 6.2 show the average annual water balance for the combined Glennies-Camberwell mining operations, including underground mining activities, for situations with and without the proposed Glennies Creek Open Cut.

Table 6.1 Overall Water Balance for Combined Glennies Creek and Camberwell Operations, Without the Proposed Glennies Creek Open Cut

Parameter	Volume	
	m ³ /day	ML/Year
Water Supply		
Rainfall Deep Percolation	1,700	620
Underground Mining (net)	200	73
Regional Groundwater	100	37
Camberwell Open Cut	3,250	1,186
Total Supply	5,250	1,916
Water Demand		
Coal Handling And Processing Plant (net)	3,000	1,095
Possum Skin Dam Evaporation	500	183
Haul Road Dust Suppression	1200	438
Dirty Water Dam Evaporation	250	91
Export to Other Mines	300	109
Total Demand	5,250	1,916

Table 6.2 Overall Water Balance for Combined Glennies Creek and Camberwell Operations, With the Proposed Glennies Creek Open Cut

Parameter	Volume	
	m ³ /day	ML/Year
Water Supply		
Rainfall Deep Percolation	1,700	620
Underground Mining (net)	200	73
Regional Groundwater	100	37
Camberwell Open Cut	3,250	1,186
Proposed Glennies Creek Open Cut	600	219
Total Supply	5,850	2,135
Water Demand		
Coal Handling And Processing Plant (net)	3,000	1,095
Possum Skin Dam Evaporation	500	183
Haul Road Dust Suppression	1400	511
Dirty Water Dam Evaporation	250	91
Export to Other Mines	700	256
Total Demand	5,850	2,135

With respect to the overall water balance, the following is of note:

- The amount of water available for export will vary depending on the stage of mining activity for the combined mines and the amount of rainfall on the mine site catchments;
- Integra Coal has contractual arrangements to export excess water to neighbouring Rix's Creek and Ashton Mines. Therefore, any excess water from the combined operations can be easily exported from the site to maintain adequate freeboards in the underground mine portal sump and the Possum Skin Dam storage.

7

SURFACE WATER MONITORING AND REPORTING

The following actions and monitoring programs are proposed to monitor potential surface water impacts if mining Longwall Panels 10 to 17.

- Assess whether rapid changes in channel or floodplain form occur in the aftermath of runoff events. This will be done by defining cross-section locations with pegs. The cross-sections surveyed as part of the erosion and flood studies will be used to provide the baseline data. These cross-sections will be resurveyed after mining has occurred and/or following a major flood event to compare the post-subsidence survey results against the existing survey results. If adverse effects are observed, remedial measures will be undertaken as appropriate.
- A photographic record of the creek and dam walls will be kept to monitor historical (baseline) rates of erosion. Photographs will be taken at similar locations for later identification and comparison following significant runoff events to assess pre and post event rates of erosion. If adverse effects are observed, remedial measures will be undertaken as appropriate. The photographic record will be kept on site.
- The post-subsidence Diversion 2 channel upstream of the backfill (the North-South section) does not meet the hydraulic performance criteria for shear stress and stream power along the upper 800m length. The diversion channel drains into the mine subsidence zone along this reach. This section will be monitored for increased channel erosion using survey and photographs. If increased channel erosion is observed, remedial measures will be undertaken as appropriate
- It is not anticipated that that subsidence under or near the dams will significantly affect the stability of the dams above Longwall Panels 10 to 17. However, the monitoring and management strategy currently adopted for Longwall Panels 7 to 9 (as detailed in GeoTerra, 2006) will also be adopted for Longwall Panels 10 to 17.
- A regular water quality monitoring program will be implemented to monitor creek and dam water quality (at least EC and pH) on an on-going basis.
- An on-going monitoring program to collect data that would assist to refine the current water balance estimates for the underground mining activities will be implemented. This will include keeping weekly records of underground mine dewatering and raw water supplies to the underground mine.

All monitoring results will be reported in the AEMR and distributed to the relevant government agencies.

8

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